Section 12
Electrical Safety Requirements

This section sets forth requirements for electrical safety. It specifically addresses working in restricted areas; working near exposed energized overhead lines or parts; operating equipment near radio and microwave transmission towers; working on electrical equipment and systems; personal protective grounding; temporary wiring; disconnect and overcurrent protection; ground-fault protection; hazardous locations; wet locations; and battery charging.

12.1 General Electrical Safety Requirements

All electrical work practices must comply with applicable sections of the Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), National Electrical Code, National Electrical Safety Code, and State adopted electrical codes.

12.1.1 **Approval Required.** Use only electrical wire, conduit, apparatus, and equipment for the specific application that is approved or listed by Underwriters Laboratories (UL), or Factory Mutual Corporation (FMC). Install and use listed, labeled, or certified equipment according to the instructions included in the listing, labeling, or certification.

12.1.2 **Qualified Persons.** Only qualified personnel familiar with code requirements, safety standards, and experienced in the type work may work on electrical circuits and equipment. NFPA 70E and OSHA 29 CFR 1910.269 contain references for training requirements. See attachment at the end of this section.

12.1.3 **Safety Requirements Before Performing Electrical Work.** The employer will determine, by inquiry, direct observation, or instruments, the location of any part of an energized electric power circuit, exposed or concealed. If the work may cause any person, tool, or machine to penetrate the boundaries set forth in table 12-1, de-energize the circuit(s) and ground them, as appropriate. A clearance may also be required. Additionally, all of the following must be required:

a. **Underground Lines.** Protect all underground lines with surface signs and a longitudinal warning tape buried 12 inches to 18 inches above the lines. Do not perform drilling, auguring, or material excavating operation within 6 feet of underground lines unless the lines have been deenergized.

b. **Job Briefing.** The supervisor or designee must conduct a job briefing with affected workers. The supervisor or designee must hold additional job briefings if significant changes occur during the course of work. The briefing must cover the following:

(1) **Job Hazard Analysis (JHA).** Identify all hazards associated with the job in a written JHA and discuss them.

(2) **Nonelectrical Hazards.** Identify, in a written JHA, hazards not associated with the electrical work but expected to be encountered, and discuss them.

(3) **Personal Protective Equipment (PPE).** Provide and use the appropriate PPE needed to accomplish the job safely. Use flash-protection clothing in accordance with NFPA 70E if the job requires operating, racking, circuit breakers with the doors open, or, working within reaching distances of exposed energized parts. Employees working on energized lines and equipment rated at 440 volts or greater must use rubber gloves, hard hats, safety boots, and other approved protective equipment or hot-line tools that meet ASTM standards.

12.1.4 **Other Procedures.** Perform procedures related to electrical work in accordance with the following:

- FIST 1-1, Hazardous Energy Control Program
- FIST 5-1, Personal Protective Grounding, and
- Written Standard Operating Procedures (SOPs) of each area office

12.2 Restricted Areas

12.2.1 **General.** Provide effective barriers or other means to ensure that people do not use areas with electrical circuits or equipment as passageways when energized lines or equipment are exposed. Effectively guard live parts of wiring or equipment to protect persons or objects from harmful contact. Use special tools insulated for the voltage when installing or removing fuses with one or both terminals energized.

12.2.2 **High-Voltage Equipment (over 600 volts nominal).** Isolate exposed high-voltage equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts to prevent unauthorized access. Isolation must consist of locked rooms, fences or screened enclosures, walls, partitions, or elevated locations. Keep entrances to isolated areas locked when not under constant observation. Post **DANGER—HIGH VOLTAGE** warning signs at entrances to these areas. Properly ground conductive components, fences, guardrails, screens, partitions, walls, and equipment frames and enclosures.

12.2.3. **Temporary Fences.** When extending a fence or removing it for work on high voltage equipment, erect a temporary fence of comparable construction and protection. Electrically bond the temporary fence to the existing fence. If the fence is more than 40 feet long, bond posts to the ground mat at no more than 40-foot intervals. Bond posts at each side

of gates or openings to the ground mat/grid and install a bonding jumper across all gate hinges. Bond all corner posts to the ground mat.

12.2.4 **Perimeter Markings.** Use approved perimeter markings to isolate restricted areas from designated work areas and entryways. Erect them before work begins and maintain them for the duration of work. Approved perimeter marking must be:

a. **Barrier Tape.** Install red barrier tape printed with the words **"DANGER—HIGH VOLTAGE"** around the perimeter of the work area and accessway approximately 42 inches above the floor or work surface.

b. **Synthetic Rope Barrier.** Install a barrier of yellow or orange synthetic rope 36 to 45 inches from the floor with standard danger signs of non-conductive material attached at 10-foot intervals containing the words **"DANGER–HIGH VOLTAGE"**.

12.3 Working Near Exposed Energized Overhead Lines or Parts

12.3.1 **General.** For troubleshooting and testing purposes only, qualified persons using proper test equipment and personal protective equipment must adhere to the boundaries shown in figure 12-1 and specified in table 12-1. For adjusting, tightening, calibrating or any other work, the circuits must be de-energized, or employees must use voltage-rated gloves and voltage-rated insulated tools.

12.3.2 **Low Voltage Testing.** For low voltage troubleshooting and testing purposes only, i.e., under 480 volts, a qualified person may penetrate the prohibited approach boundary shown in table 12-1, column 5, with test instrument probes, leads, ct's, etc. The qualified person must wear Class 00 (500 volt-rated) gloves.

12.3.3 **Unqualified Person Restrictions.** When a person without electrical training works on the ground or in an elevated position near overhead lines or any other exposed energized parts, supervisors and employees must ensure that the unqualified person and the longest conductive object they might contact or handle, can never come closer to any

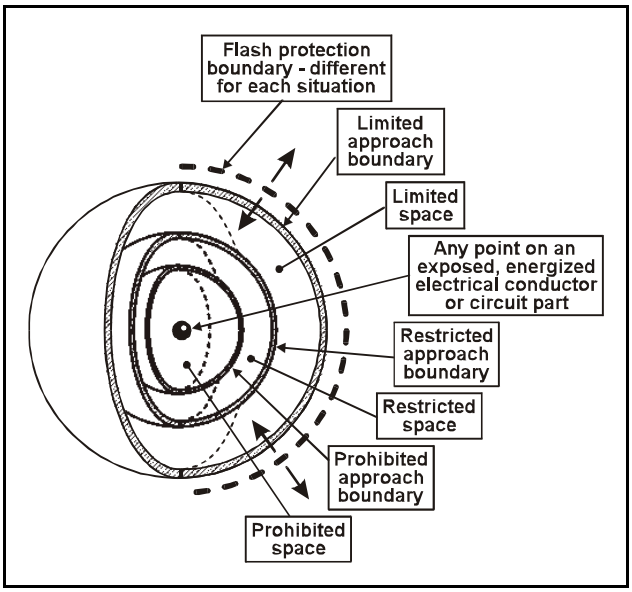

Figure 12-1.—Boundaries.

energized line or part than those distances listed in table 12-1, column 2, for energized lines or column 3 for other exposed live parts.

Table 12-1.—Approach boundaries to exposed energized conductors/parts for qualified employees
(All dimensions are distances from energized conductor/part to employee)

(1)	(2)	(3)	(4)	(5)
Nominal voltage phase to phase, or single phase	Limited approach boundaries: Exposed moveable conductor	Limited approach boundaries: Exposed fixed circuit part	Restricted approach boundary includes inadvertent movement	Prohibited approach boundary
0 to 50	not specified	not specified	not specified	not specified
51 to 300	10-ft 0-in	3-ft 6-in	avoid contact	avoid contact
301 to 750	10-ft 0-in	3-ft 6-in	1-ft 0-in	0-ft 1-in
751 to 15 kV	10-ft 0-in	5-ft 0-in	2-ft 2-in	0-ft 7-in
15.1 kV to 36 kV	10-ft 0-in	6-ft 0-in	2-ft 7-in	0-ft 10-in
36.1 kV to 46 kV	10-ft 0-in	8-ft 0-in	2-ft 9-in	1-ft 5-in
46.1 kV to 72.5 kV	10-ft 0-in	8-ft 0-in	3-ft 3-in	2-ft 1-in
72.6 kV to 121 kV	10-ft 8-in	8-ft 0-in	3-ft 2-in	2-ft 8-in
138 kV to 145 kV	11-ft 0-in	10-ft 0-in	3-ft 7-in	3-ft 1-in
161 kV to 169 kV	11-ft 8-in	11-ft 8-in	4-ft 0-in	3-ft 6-in
230 kV to 242 kV	13-ft 0-in	13-ft 0-in	5-ft 3-in	4-ft 9-in
345 kV to 362 kV	15-ft 4-in	15-ft 4-in	8-ft 6-in	8-ft 0-in
500 kV to 550 kV	19-ft 0-in	19-ft 0-in	11-ft 3-in	10-ft 9-in
765 kV to 800 kV	23-ft 9-in	23-ft 9-in	14-ft 11-in	14-ft 5-in

Notes: This table is taken from NFPA 70E table 2-1.3.4 and OSHA 29 CFR,1910.269 table R6.

Limited Approach Boundaries. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). Unqualified persons must not cross this boundary unless accompanied by a qualified person.

Restricted approach Boundary. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). The boundary's proximity to a shock hazard requires the use of shock protection techniques and equipment when crossed.

Prohibited Approach Boundary. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). When crossed by a body part or object, this boundary requires the same protection as if direct contact is made with a live part (i.e., requires voltage rated tools and voltage rated gloves and, in some cases, other voltage rated clothing).

12.3.4 **Equipment Transit Clearances.** A signal or flag person must guide cranes, cherry pickers, high lifts, and other equipment in transit near exposed energized lines or parts at all times. Do not move any equipment or machinery under energized overhead high-voltage lines or near exposed energized parts, unless clearances listed in table 12-2 are maintained. Unload and lower any boom or mast to transport position. Ground the equipment while it is being transported. Two grounds must be leap-frogged as the vehicle is moved or the vehicles must be treated as energized.

Table 12-2.—Equipment in transit clearances

Up to 50 kV	4 feet
50kv up to and including 345 kV	10 feet
over 345 kV up to 750 kV	16 feet

12.3.5 **Sign Posting.** Post all crossings where equipment will be moved under energized high-voltage line(s) with appropriate signs. Place the signs 50 feet from and on both sides of the line(s). They must be large enough to be easily read from moving equipment. The sign must include the following information:

- Warning of the high-voltage line
- Line voltage
- Maximum height of equipment that may pass under the line. Determine the maximum height of the equipment by subtracting the clearance distance shown in table 12-2 from the actual line to ground distance during maximum sag conditions.

12.3.6 **Equipment Operation Near Energized Lines.** Prohibit equipment from coming any closer to overhead high-voltage lines or exposed energized parts than distances shown in table 12-3, unless both subparagraphs a. and b. below are satisfied, or subparagraph c. below is satisfied.

a. Before beginning work, place a clearance, ground and de-energize the line or exposed energized parts, and implement hazardous energy control procedures to prevent re-energization.

b. Equipment does not have the capability of coming within distances shown in table 12-3.

Table 12-3.—Equipment clearances for operations near energized overhead lines

Table of minimum clearances (ft) for nominal system voltages (kV)	
kV	Ft
50 (or less)	10
69	11
115	12
230	16
500	25

c. In addition to the clearances in table 12-3, effectively ground all equipment with booms or extensions above cab level while it is operating in a substation, switchyard, or on a transformer deck, or any other location near high voltage energized lines/parts.

Note: Table 12-3 shows only common Reclamation voltages and rounds them up to the nearest foot. For other voltages, use the 10-foot minimum and add 4 inches for every 10 kilovolts over 50 kilovolts. For example, 60 kilovolts would be 10 feet plus 4 inches; rounding up to the nearest foot would require an 11-foot clearance. Always round up because the clearance is usually only an estimate. It is difficult, if not impossible, to accurately measure the actual distance unless you de-energize the line and/or equipment.

12.3.7 **Placard Posting in Equipment Cabs.** Post a placard of minimum clearances (table 12-3) in the cabs of all cranes, cherry pickers, shovels, backhoes, and any other equipment with booms or extensions that could possibly contact high-voltage lines. Tables posted in machines must be of substantial material and suitable for the environment.

12.4 Operating Equipment Near Radio and Microwave Transmission Towers

12.4.1 **General.** Because of high frequency, low power output, and point-to-point transmissions, microwave transmissions do not present an induced charge hazard. However, many microwave towers are mounted on VHF radio transmission antennas. Therefore, the following safety precautions apply to all transmission towers. Vehicles will rarely need to be grounded at transmission towers. Tires contain carbon compounds and are conductive or semiconductive, and static charges will bleed off through tires and/or out-riggers. However, voltage could build up if all tires were insulated from the earth by dry rip-rap or other insulation.

12.4.2 **Requirement.** Shut down the transmitter or ground and test the equipment to determine if a hazard exists before working near any transmission tower where an electrical charge may be induced in the equipment or materials being handled. To conduct a test, connect an insulated wire to the vehicle and touch it to the tower base. If you see or hear the spark, you must ground the vehicle.

12.4.3 **Grounding Mobile Equipment Near Transmission Towers.** If needed, ground the equipment to dissipate static electrical charge. On equipment with a rotating boom, attach a ground wire to the structure supporting the boom. Place and remove ground wires using hot-sticks or voltage-rated gloves. Attach the ground connection first (if possible, to the tower ground), then attach the other end to the equipment. These ground wires do not have to be sized to carry fault current. They need only to carry low level current to bleed off static voltage charges induced on the vehicle or lifted materials. Any convenient wire size that will mechanically withstand the service will be sufficient. A smaller conductor would carry the current, but an insulated #2 copper conductor is recommended for mechanical strength.

12.4.4 **Material Ground Wire.** Also, attach a ground wire to conductive materials handled by hoisting equipment. Attach the ground connection first, then attach the other end on the materials. Alternatively, provide a ground jumper from the load to the required grounding conductor installed on the structure.

12.5 Working on Electrical Equipment and Systems

12.5.1 **General.** Electrical installations must comply with the applicable provisions of the current editions of the National Electrical Safety Code, National Electrical Code, OSHA Regulations, and the Reclamation Safety and Health Standards. The Underwriters Laboratories, Factory Mutual Laboratories, or other nationally recognized testing laboratory must approve or list electrical wire, conduit, apparatus, power tools and equipment, for the specific application. This approval/listing must appear on each piece of equipment or tool as part of the "marking or labeling" required below.

12.5.2 **Marking or Labeling.** Do not use electrical equipment unless the manufacturer's name, trademark, and other descriptive marking by which the manufacturer may be identified, is located on the equipment. Markings must also provide voltage, current, wattage, approvals/listings, and ratings as required by the edition of the National Electric Code in effect at the time of purchase. Markings must be sufficiently durability to withstand the environment.

12.5.3 **Working Space**

a. Figure 12-2 and table 12-4 provide access and working space distances around electrical equipment and enclosures, e.g., panelboards, motor controls, disconnects, etc., to permit ready and safe operation and maintenance. Keep working space clear at all times.

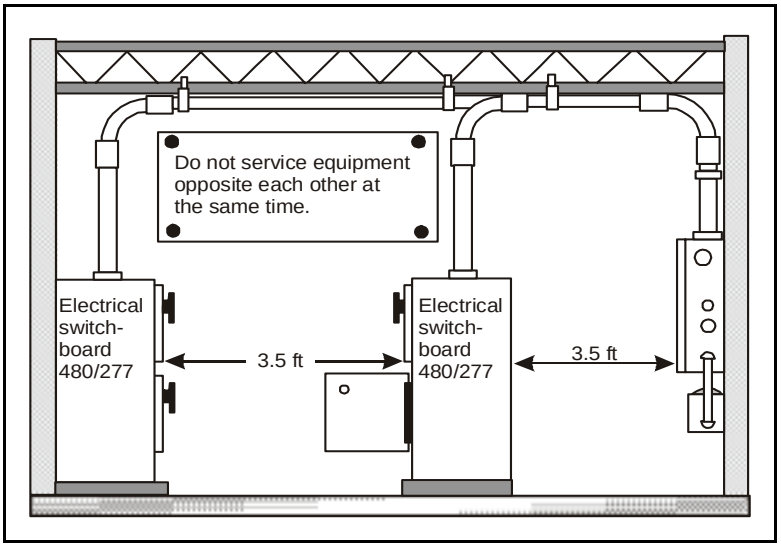

Figure 12-2.—Access and working space requirements around enclosures and equipment.

Table 12-4.—Working spaces around enclosures and equipment

Working spaces			
	Minimum clear distance (ft)		
Nominal voltage to ground	Condition 1	Condition 2	Condition 3
0-150	3	3	3
151-600	3	3.5	4
601-2500	3	4	5
2501-9000	4	5	6
9001-25000	5	6	6

Condition 1 - Exposed live parts on one side and no live parts or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated busbars operating at not over 300 volts to ground shall not be considered live parts.

Condition 2 - Exposed live parts on one side and grounded parts on the other side. Consider concrete, brick, or tile walls grounded.

Condition 3 - Exposed live parts on both sides of the work space (not guarded or enclosed, as provided in Condition 1) with the worker between.

b. Provide a working space of at least 30 inches horizontally where rear or side access is required to work on de-energized parts of enclosed equipment (see figure 12-3).

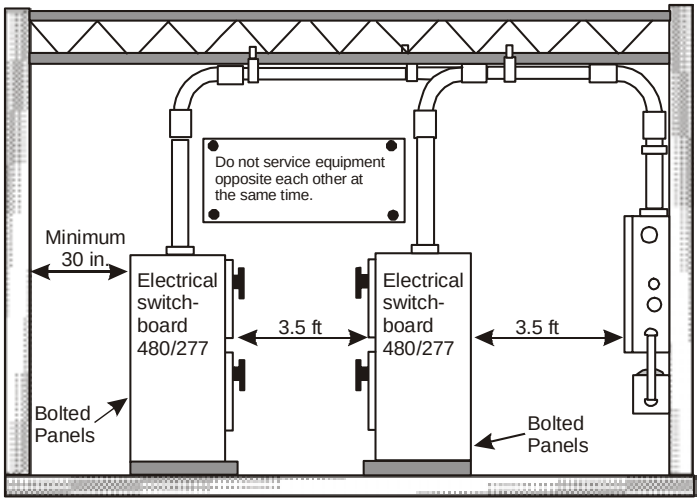

Figure 12-3.—Working space requirements for rear or side access.

c. Doors and hinged panels. Doors and hinged panels must have at least at least a 90-degree opening. Keep working space clear at all times. Do not store parts, tools, and equipment (see figure 12-4).

12.5.4 **Passageway Barriers.** Provide effective barriers or other means (barrier tape) to ensure that areas containing electrical circuits or equipment are not used as passageways when energized lines or equipment are exposed for testing or maintenance. This includes open doors on motor control centers, and switchgear.

12.6 Personal Protective Grounding

12.6.1 **General.** Qualified persons must comply with applicable provisions of FIST Volume 5-1 "Personal Protective Grounding." Include written grounding procedures in all clearances, special work permits, etc. The JHA must include the procedures, and employees must discuss them before beginning work.

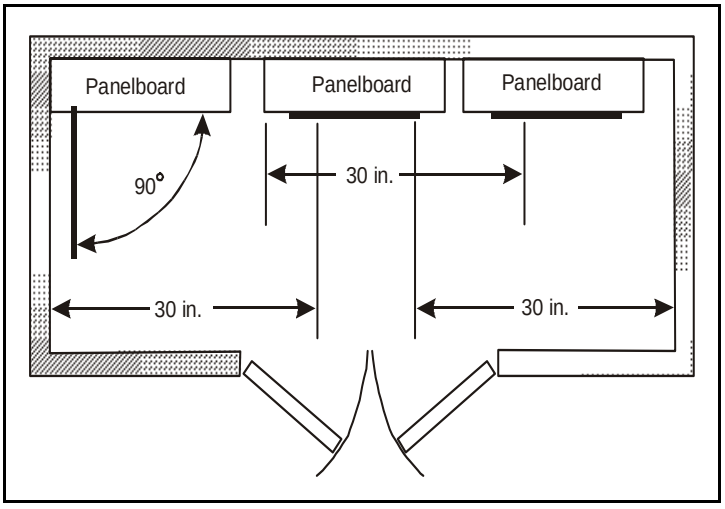

Figure 12-4.—Working space requirements for doors and hinged panels.

12.6.2 **Over 600 Volts.** Place grounds as close as possible to the work and within sight of the workers

for all electrical circuits and equipment operated in excess of 600 volts. The clearance holder is personally responsible for proper placement and removal of protective grounds.

12.6.3 **Personal Protective Ground Cables.** Personal protective grounds and clamps must be capable of conducting the calculated maximum fault current available for the time necessary to clear the fault. They must be sized in accordance with FIST 5-1.

12.6.4 **Prior to Applying Grounds.** After implementing hazardous energy control, use a hot-stick "noise tester" or similar approved device of sufficient insulating capacity to verify that the circuit or equipment is de-energized before placing personal protective grounds. Test the voltage tester immediately before use on a known energized source of similar voltage before testing the equipment to be worked on. The circuit/equipment to be worked on must be considered energized while conducting the test.

12.6.5 **Placement and Removal of Personal Protective Grounds.** After de-energization, install personal protective grounds so that all phases of lines and equipment are visibly and effectively bonded together in a multi-phase short and connected to ground at one point. Do not use single-phase personal protective grounds or grounding chains. Install personal protective grounds using a hot-stick or voltage-rated gloves on both sides of the work area, if possible. This precaution prevents a possible backfeed, especially when working on transformers and related equipment. When attaching grounds, attach the ground end first, and then attach the other end to the de-energized circuit. When removing personal protective grounds, first remove the grounding clamp from the de-energized circuit using a hot stick or voltage-rated gloves, and then remove the other end from the ground connection.

12.7 Temporary Wiring

12.7.1 **Installation.** Temporary wiring must meet all the requirements of the National Electrical Code (NEC). Permit temporary wiring only during the period of construction, remodeling, maintenance, repair, or demolition. Remove temporary wiring immediately upon completion of construction or purposes for which the wiring was installed. Permit temporary wiring used for feeders and branch circuits in multi-conductor cord or cable assemblies or open conductors, and guard, bury, or isolate it by elevation to prevent accidental contact by personnel or equipment. Allow at least 10 feet of vertical clearance above walkways for circuits rated 600 volts or less. Support all exposed temporary wiring on insulators. Provide ground fault protection for personnel for all temporary wiring installations to comply with the National Electrical Code.

12.7.2 **Weatherproof.** Conductors used in tunnels, shafts, trenches, and wet or damp locations must be of a type approved for the purpose as listed in Article 310 of the NEC.

12.7.3 **Bushings.** Wiring installed in conduit must be equipped with bushings at ends of conduit.

12.7.4 **Receptacles.** All receptacles must be of the grounding type and must be electrically connected to the equipment grounding conductor. Do not install receptacles on construction sites on branch circuits that supply temporary lighting. Do not connect receptacles to the same ungrounded conductor of multiwire circuits that supply temporary wiring.

12.7.5 **Lighting Strings.** Temporary lighting strings must consist of nonconductive lamp sockets and connections permanently molded to the conductor insulation. Use lamp guards to protect bulbs attached to festoon lighting strings and extension cords. Promptly replace broken or defective bulbs. Protect all lights used for illumination from accidental contact or breakage.

12.7.6 **Extension Cords.** Extension cords must be 3-wire grounded type, must be designated for hard service or extra hard service, and must be listed by the Underwriters Laboratories. Do not exceed the rated load. Use cords only in continuous lengths without splice. However, use suitably molded or vulcanized splices when suitably made with insulation equal to the cord being spliced and soldered or with wire connections or other type connections conforming to the National Electrical Code. Do not use worn or frayed extension cords. To protect cable assemblies, flexible cords, and cables from damage, support them in place with approved staples, cable ties, straps, or similar type fittings installed to prevent damage.

12.8 Disconnect and Overcurrent Protection

12.8.1 **Marking.** Plainly mark, label, or arrange switches, fuses, and automatic circuit breakers to identify the circuits or equipment controlled by them.

12.8.2 **Switches.** Switches must be of the enclosed safety type, with the enclosures grounded, and installed so as to minimize the possibility of accidental operation.

12.8.3 **Lockout Provision.** Provide switches and breakers with a means of locking in the OFF position. Also, fuse cabinets and circuit breaker cabinets must be equipped with lockable doors.

12.8.4 **Wet and Outside Locations.** Enclose switches, circuit breakers, fuse panels, and motor controllers in wet or outside locations in approved weatherproof cabinets or enclosures. Prevent moisture or water from entering or accumulating within the cabinets or enclosure.

12.8.5 **Shielding.** Isolate or shield the disconnecting means to protect employees.

12.8.6 **Service Entrance Disconnect.** Install the service entrance disconnecting means in a readily accessible location, as close as possible to the point where the service entrance conductors enter the premise. The service disconnecting means must disconnect all the ungrounded service entrance conductors supplying power to the service equipment. This disconnecting means must plainly indicate that it is either in the open or closed position.

12.8.7 **Overcurrent Protection.** Fuses or circuit breakers must provide overcurrent protection for all ungrounded conductors. All overcurrent protection devices and conductors must be designed and installed according to the latest provisions of the NEC to ensure protection and proper installation. Do not place any overcurrent device in any permanently grounded conductor, except where the overcurrent device simultaneously opens all conductors of the circuit.

12.9 Ground-Fault Protection

12.9.1 **Requirement.** Protect all 125-volt, single-phase, 15 and 20 ampere receptacles outlets used in locations such as laboratories, shops, garages, wet locations, outdoor receptacles, bathrooms, kitchens, and for construction operations with a ground-fault circuit interrupter (GFCI). For temporary wiring, all 125 volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not a part of the permanent wiring of the building or structure and that employees use must have ground-fault circuit interrupter protection for personnel. For temporary wiring, receptacles other than 125 volt, single-phase, 15-, 20-, and 30-ampere receptacles must have ground-fault circuit protection or protection in accordance with the assured equipment grounding conductor program. The ground-fault interrupter must open the circuit on a ground current of 5 milliamperes plus or minus 1 and must be equipped with an integral push-button test circuit. Install the GFCI in accordance with the manufacturer's instructions and test it before initial use and periodically thereafter.

12.9.2 **Assured Equipment Grounding Conductor Program.** Where GFCI protection is not provided for personnel, the Assured Equipment Grounding Conductor Program must be implemented. This program must be used on all receptacle outlets, except 125-volt, single-phase, 15-, 20-, and 30-amp receptacle outlets, used during construction, remodeling, maintenance, repair or demolition of buildings, structures, equipment, or similar activities. Receptacle outlets must not be connected to any branch circuits that supply power to lighting outlets, per NEC 305-4(d).

a. All cord sets and receptacles that are not part of the permanent wiring of the building or structure, as well as cord and plug connected equipment required to be grounded, must meet the following requirements:

- Have a written description of the program
- Have a qualified person to implement the program

b. All equipment grounding conductors must be tested for continuity and be electrically continuous.

c. Each receptacle and attachment plug must be tested for correct attachment of the equipment grounding conductor.

d. Tests are required under the following conditions for an Assured Equipment Grounding Program:

- Before first use onsite
- When there is evidence of damage
- Before equipment is returned to service following any repairs
- At intervals not exceeding 3 months

e. The required test for all equipment grounding conductors and each receptacle and attachment plug above must be recorded and available for inspection.

12.10 Hazardous Locations

12.10.1 **General.** A hazardous location is any location where a potential hazard, either a fire or an explosion, can exist because of the presence of flammable, combustible, or ignitable materials. These materials can consist of gases, vapors, liquids, dust, fibers, etc. Hazardous locations are classified according to the properties and quantities of the hazardous material that may be present. Hazardous locations are divided into three classes, two divisions, and seven classified groups as follows: Class I, II, and III; Division 1 and 2; and Groups A, B, C, D, E, F, and G. Wiring methods used in hazardous locations must comply with more stringent requirements than wiring methods used in other locations.

12.10.2 **Requirement.** Electrical wiring and equipment installed in hazardous locations, as defined in the National Electrical Code, must conform to the respective standards. All components and equipment used in hazardous locations must be from among the equipment listed by a nationally recognized testing laboratory, such as Underwriters Laboratories, Inc., or Factory Mutual Engineering Corporation.

12.10.3 **Marking.** Approved equipment must be marked to show the class, group, and operating temperature or temperature range referenced to a 40 degree C ambient. Install approved equipment in accordance with the requirements of the NEC.

12.10.4 **Intrinsically Safe Systems.** Permit intrinsically safe apparatus and wiring in any hazardous (classified) location for which it is approved.

12.10.5 **Maintenance.** Maintain wiring components and equipment as explosion-proof. There must be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to tight conditions.

12.11 Wet Locations

12.11.1 **Requirement.** Only the following type electrical systems are permissible for use in wet areas where there is danger of electrical shock:

a. **Ground-Fault Circuit Interrupter.** Electrical circuits for lighting and hand tools must not exceed 120 volts and must be protected by UL-listed ground-fault circuit interrupters installed in conformance with the manufacturer's specifications, and tested before beginning work.

b. **Stationary Portable Equipment.** Connect stationary portable electrically powered equipment, such as pumps, heaters, blowers, welders, transformers, etc., to a circuit protected by a ground-fault circuit interrupter or effectively ground the equipment with both an internal grounding system and a visible flexible copper ground wire.

c. **Substitute Equipment.** Whenever practical, substitute air, battery, or hydraulically powered tools for electrically powered tools.

12.11.2 **Receptacles.** Receptacles and cord connectors used in damp or wet locations must be designed for use in wet or damp locations and, unless approved for submersion, must not be allowed to lie in water.

12.12 Battery Charging

12.12.1 **Requirement.** Restrict battery charging operations to well-ventilated areas designated for that purpose. Post signs with the following wording (or equivalent) at all entrances when explosive gases are produced: "BATTERY ROOM - NO SMOKING OR OPEN FLAME WITHIN 25 FEET."

12.12.2 **Ventilation.** Ventilation must be adequate to ensure diffusion of the battery gases and prevent accumulation of an explosive mixture.

12.12.3 **Vented Batteries.** Locate nonseal-type batteries in enclosures with outside vents or in well-ventilated rooms, arranged to prevent the escape of fumes, gases, or electrolyte spray or liquid into other areas. Keep safety vent caps in place during charging.

12.12.4 **Racks and Trays.** Racks and trays must be of sufficient strength and treated with an electrolyte resistive coating.

12.12.5 **Housekeeping.** Keep battery storage and charging areas free of combustible materials and scrap. Promptly clean up and dispose of acid or corrosive spills.

12.12.6 **Protective Equipment.** Provide face shields, goggles, aprons, and rubber gloves for employees who handle acids or recharging batteries.

12.12.7 **First Aid.** Provide facilities for quick emergency drenching of the eyes and body within 25 feet of a battery charging area.

Attachment 12-1
Training Requirements for Electrically Qualified Persons

1. **General.** NFPA 70E, 2000 Edition, and OSHA 29 CFR 1910.269 contains references for training requirements. A person must have all the training listed below to be a qualified person.

a. Required training must be of classroom and on-the-job training.

b. Qualified persons must be trained in and familiar with "Safety-Related Work Practices," safety procedures, and other safety requirements pertaining to their work. Qualified persons must be trained in first aid and CPR and be familiar with applicable emergency procedures. They must be trained in any other safety practices, including those not specifically addressed in this section such as confined space entry, manhole and pole-top rescue, fall protection, personal protective equipment, etc.

c. Qualified persons must be trained and knowledgeable in Job Hazard Analysis (JHA). This training and knowledge includes recognizing work hazards, doing the work safely, writing a JHA, and communicating hazards and safety work practices to fellow employees.

d. Qualified persons must be trained and knowledgeable in the construction, operation, and maintenance of equipment and specific work methods. They must be trained to recognize and avoid hazards with respect to equipment or work methods and must be familiar with applicable codes and standards. They shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools and test equipment.

2. **Additional Training Required.** Qualified persons permitted to work within limited approach boundaries (table 12-1) of exposed conductors and parts must, at a minimum, be additionally trained in all of the following:

a. Skills and techniques necessary to distinguish exposed energized parts from other parts.

b. Skills and techniques necessary to determine the nominal voltage of exposed energized parts. These skills and techniques include those necessary to safely use high and low-voltage meters, test instruments, and personal protective equipment while performing measurements and testing.

c. The approach distances specified in table 12-1 and corresponding voltages to which the qualified person will be exposed. (Post table 12-1 in the Electric Shop and hand it out to each team member before beginning work on a project that involves work near exposed energized lines or other equipment.)

d. The decision-making process to determine the degree and extent of the hazard and the personal protective equipment necessary to perform the task safely. For example, clothing that would increase injury by fire is not permitted. Clothing made of acetate, nylon, polyester, and rayon is prohibited. Refer to OSHA 29 CFR 1910.269 on apparel.

e. Lockout/Tagout and clearance procedures of FIST 1-1.

3. **In-Training.** A person who is undergoing on-the-job training and who, in the course of this training, has demonstrated the ability to perform specific duties safely at his or her level of training, and is under the direct supervision of a qualified person, is considered a qualified person for the performance of those specific duties only. For qualified persons, the employer must determine by regular supervision and inspections of the employee's work and his/her on-the-job work practices, at least annually, that each qualified person is complying with the safety-related-work practices required.

4. **Training Documentation.** The employer must generate and maintain written documentation that each employee has received the required training. The employer must verify that the training has been accomplished and is current. The documentation must contain the employee's name, the training he/she has received, and dates of training. Employee demonstrate their competence by their proficiency in safety-on-the-job and work practices. Maintain training records in the employee's training file for the duration of employment. Employment records that indicate an employee has received the required training are an acceptable means of meeting this requirement.

5. **An employee must receive additional training (or re-training) under any of the following conditions:**

- If supervision and/or annual inspections of the employees work and on-the-job, safety-related work practices indicate the employee is not knowledgeable or complying with the requirements of this section.

- If new technology, new type equipment, or changes in procedures dictate the use of safety-related work practices that are different from those which the employee would normally use.

- If the worker must use safety-related practices not normally used during normal job duties.

- If the worker has not performed this specific task within 1 year or feels a need for additional training to perform the job safely.

- If the worker's other qualifications have expired, such as First Aid and CPR.

Note: Employee who perform a task less than once a year must receive hazard retraining before the employee may perform the task again. Retraining may be done during the JHA, but must also include a jobsite visit to discuss hazards. Performing a task less than once a year is not considered a part of normal job duties.